CLAIMS

What is claimed is:

1. A method for performing both single-carrier and multi-carrier reception, comprising steps of:

downconverting received RF signals to in-phase (I) and quadrature (Q) channel signals each comprising a plurality of sub-carriers at a low intermediate frequency (low-IF) and, if required, one sub-carrier or a single carrier centered around 0 Hz;

filtering interfering signals outside of a frequency band of interest with analog filters in the I and Q channels;

converting the I and Q channel signals to digital representations thereof;

in the multi-carrier reception case, separating sub-carriers that are images of one another by quadrature downmixing the digital representations of the I and Q channel signals to baseband in the digital domain; and

digitally adding or subtracting resulting I and Q signals to obtain one or both of an upper sideband and a lower sideband containing desired ones of the sub-carriers.

2. A method as in claim 1, wherein for a symmetric multi-carrier reception case the step of downconverting includes a step of tuning a local oscillator to a center frequency of a group of sub-carriers.

3 A method as in claim 1, wherein for an asymmetric multi-carrier reception case the step of downconverting includes a step of tuning a local oscillator between a middlemost sub-carrier and its interfering adjacent channel.

4. A method as in claim 1, wherein digital filtering provides a final selectivity for each of the sub-carriers.

5. A method as in claim 1, wherein in the multi-carrier operation case a wideband analog lowpass filter is replaced by narrower filters having bandwidths set by the bandwidth of the individual sub-carriers, and whose center frequencies are one of fixed or tunable.

6. A method as in claim 1, wherein in the single carrier reception case the receiver works either in a direct conversion or a low-IF mode, and changing from multi-carrier reception to single carrier reception comprises steps of tuning an analog baseband filter bandwidth to account for the single carrier bandwidth, adjusting an analog-to-digital converter bandwidth and dynamic range for single carrier reception, and wherein digital quadrature downmixing and digital adders may be reconfigurated or deactivated.

7. A method as in claim 1, wherein in the single carrier reception case the receiver operates in an IF mode, and wherein changing from single carrier to multi-carrier reception comprises steps of bypassing an RF mixer and an IF-filter, tuning an analog baseband filter bandwidth to account for the multi-carrier signal bandwidth, adjusting an analog-to-digital converter bandwidth and dynamic range for multi-carrier reception, and where digital quadrature downmixing and digital adders are activated.

8. A method as in claim 1, wherein after analog-to-digital conversion the amplitude and phase imbalances between I and Q channels are compensated to maximize unwanted sideband suppression.

9. A method as in claim 1, wherein in the multi-carrier reception case the receiver gain in analog circuitry is adjusted based on the power of all sub-carriers, or if the sub-carrier spacing is sufficiently small, is based on the power of one of the sub-carriers.

10. A method as in claim 1, wherein in the multi-carrier reception case the receiver gain in digital circuitry is adjusted separately for each sub-carrier, or if the sub-carrier spacing is sufficiently small, all sub-carriers are provided the same digital gain.

11. A receiver for single-carrier and multi-carrier reception, comprising:

downconverter circuitry for downconverting received RF signals to in-phase (I) and quadrature (Q) channel signals each comprising a plurality of sub-carriers at a low intermediate frequency (low-IF) and, if required, one sub-carrier or a single carrier centered around 0 Hz;

analog low pass filters with tunable corner frequencies for filtering interfering signals outside of a frequency band of interest in the I and Q channels;

I and Q channel analog-to-digital converters for converting I and Q channel signals to digital representations thereof;

I and Q channel quadrature downmixers for separating sub-carriers that are images of one another by quadrature downmixing the digital representations of the I and Q channel signals to baseband in the digital domain; and

digital adder logic for selectively adding or subtracting resulting I and Q signals to obtain one or both of an upper sideband and a lower sideband containing desired ones of the sub-carriers.

12. A receiver as in claim 11, wherein for a symmetric multi-carrier reception case said downconverter circuitry is operated by tuning a local oscillator to a center frequency of a group of sub-carriers.

13 A receiver as in claim 11, wherein for an asymmetric multi-carrier reception case said downconverter circuitry is operated by tuning a local oscillator between a middlemost sub-carrier and its interfering adjacent channel.

14. A receiver as in claim 11, wherein for a multi-carrier reception case said analog lowpass filters are each replaced by at least one narrower bandwidth filter whose bandwidth is set by the bandwidth of the individual sub-carriers and whose center frequency is one of fixed or tunable.

15. A receiver as in claim 11, wherein to accommodate both single-carrier and multi-carrier reception, the corner frequency of said analog lowpass filter and the bandwidth and dynamic range of said analog-to-digital converter are adjustable, and said digital downmixing and adder logic is deactivated when not needed.

16. A receiver as in claim 11, wherein to accommodate both single-carrier and multi-carrier reception, said receiver further comprises a switch structure for bypassing an RF mixer and an IF filter used for single carrier reception.

17. A receiver as in claim 11, and further comprising digital logic which compensates amplitude and phase imbalances between the digital I and Q signals.

18. A receiver as in claim 11, and further comprising digital logic for measuring sub-carrier power in the multi-carrier reception case.

19. A receiver as in claim 11, wherein in the multi-carrier reception case said receiver further comprises, for each sub-carrier, a digital gain block for independently adjusting sub-carrier power.

20. A mobile station, comprising a receive antenna and a digital signal processor (DSP), said mobile station further comprising a receiver having an input coupled to said antenna and an output coupled to an input of said DSP, said

receiver being capable of multi-carrier reception and comprising:

> downconverter circuitry for downconverting received RF signals to in-phase (I) and quadrature (Q) channel signals each comprising a plurality of sub-carriers at a low intermediate frequency (low-IF) and, if required, one sub-carrier or a single carrier centered around 0 Hz;
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> analog low pass filters having tunable corner frequencies for filtering interfering signals outside of a frequency band of interest in the I and Q channels;
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> I and Q channel analog-to-digital converters for converting I and Q channel signals to digital representations thereof;
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> I and Q channel quadrature downmixers for separating sub-carriers that are images of one another by quadrature downmixing the digital representations of the I and Q channel signals to baseband in the digital domain; and
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> digital adder logic for selectively adding or subtracting resulting I and Q signals to obtain one or both of an upper sideband and a lower sideband containing desired ones of the sub-carriers.

21. A mobile station receiver as in claim 20, wherein for a symmetric multi-carrier reception case said downconverter circuitry is operated by tuning a local oscillator to a center frequency of a group of sub-carriers.

22. A mobile station receiver as in claim 20, wherein for an asymmetric multi-carrier reception case said downconverter circuitry is operated by tuning a local oscillator between a middlemost sub-carrier and its interfering adjacent channel.

23. A mobile station receiver as in claim 20, wherein for a multi-carrier reception case said analog lowpass filters are each replaced by at least one narrower bandwidth filter whose bandwidth is set by the bandwidth of the individual sub-carriers and whose center frequency is one of fixed or tunable. .

24. A mobile station receiver as in claim 20, wherein to accommodate both single-carrier and multi-carrier reception, the corner frequency of said analog lowpass filter and the bandwidth and dynamic range of said analog-to-digital converter are adjustable, and said digital downmixing and adder logic is deactivated when not needed.

25. A mobile station receiver as in claim 20, wherein to accommodate both single-carrier and multi-carrier reception, said receiver further comprises a switch structure for bypassing an RF mixer and an IF filter used for single carrier reception.

26. A mobile station receiver as in claim 20, and further comprising digital logic for compensating amplitude and phase imbalances between the digital I and Q signals.

27. A mobile station receiver as in claim 20, and further comprising digital logic for measuring power in all sub-carriers in the multi-carrier reception case.

28. A mobile station receiver as in claim 20, wherein in the multi-carrier reception case said receiver further comprises, for each sub-carrier, a digital gain block for independently adjusting sub-carrier power.

29. In a receiver used for single carrier reception, a method for performing multi-carrier reception, comprising steps of:

downconverting received RF signals to in-phase (I) and quadrature (Q)

channel signals each comprising a plurality of sub-carriers at a low intermediate frequency (low-IF);

converting the I and Q channel signals to digital representations thereof;

separating sub-carriers that are images of one another by quadrature downmixing the digital representations of the I and Q channel signals to baseband in the digital domain; and

selectively adding or subtracting the resulting downmixed digital representations of the I and Q signals to obtain at least one of an upper sideband and a lower sideband containing desired ones of the sub-carriers.

30. A method as in claim 29, wherein the step of downconverting received RF signals also generates a sub-carrier centered at about 0 Hz.